ASSESSMENT OF ASCAT HIGH WIND RETRIEVALS WITHIN EXTRATROPICAL CYCLONES AT NOAA OCEAN PREDICTION CENTER

Khalil A. Ahmad, Zorana Jelenak, Joseph Sienkiewicz, and Paul Chang

NOAA/NESDIS/Center of Satellite Application and Research (StAR)

1. INTRODUCTION

The Advanced SCATterometer (ASCAT) is a microwave radar launched abroad the European MetOp-A satellite in October 2006. ASCAT operates at a C-band frequency of 5.255 GHz, and utilizes a fan-beam antenna system to collect the vertically polarized microwave backscatter measurements at multiple azimuth angles from the wind roughened ocean surface. ASCAT infers the oceanic wind vector (magnitude and direction) by inverting a Geophysical Model Function (GMF) that relates the backscatter measurements to the near surface wind vector. The ASCAT Ocean Surface Vector Wind (OSVW) data are processed and distributed in near real-time by NOAA / NESDIS, and have been available to the operational weather forecasting community since the summer of 2007.

The NOAA Ocean Prediction Center (OPC) is an integral component of the National Centers for Environmental Prediction (NCEP) within the National Weather Service (NWS), and has marine forecast and wind warning responsibilities over the vast North Atlantic and North Pacific extra-tropical high seas, including the offshore waters of the continental United States. The wind warnings issued by OPC are based upon Beaufort wind speed scale, and fall into three categories: Gale-force (34 – 47 knots), Storm-force (48 – 63 knots), and hurricane - force (HF) for wind speeds of 64 knots or greater.

Extratropical cyclones are a principal source for the issuance of wind warnings in the OPC waters of responsibility. They vary on scale from less than 100 km in diameter up to 4,000 km in diameter, and have an average life cycle of five days from genesis to death. Associated wind conditions can range from light (10 to 20 knots), near gale (25 to 32 knots), to higher wind speeds of Gale force, Storm force, or HF conditions. During cold seasons, five to as many as eight individual cyclones can impact the Atlantic basin, and up to seven to eleven the Pacific basin. The remotely sensed OSVW data from ASCAT (and previously from QuikSCAT) have proven to provide extremely useful information to the OPC forecasters on the detection and identification of near-surface frontal, and wind field structures associated with these extratropical cyclone systems, over an otherwise data sparse area of responsibility.

2. EVALUATION RESULTS

A previous assessment study of ASCAT retrievals, conducted at OPC [1], showed that ASCAT can reliably retrieve low to moderate surface wind speeds in all weather conditions. However, for higher wind speeds, ASCAT retrievals were found to have an increasingly low wind speed bias compared to QuikSCAT and Global Forecast System (GFS) winds. The low wind speed bias limited the utility of ASCAT winds in support of OPC's high wind warnings functions, especially, the most dangerous Hurricane Force (HF) category.

In an effort to improve the performance of the ASCAT high wind retrievals, NOAA / NESDIS has developed a new GMF by exploiting additional sensitivity of ASCAT backscatter measurements to collocated high wind events observed by QuikSCAT, and the high wind GMF derived from airborne IWRAP instrument [2]. The new GMF has been recently implemented in the ASCAT wind processor, and new ASCAT OSVW retrievals are being produced and distributed to operational weather centers.

In this paper, we present an evaluation of the new ASCAT retrievals in support of OPC's analysis and warning operations, with emphasis on the utility of the ASCAT OSVW data in detecting intense extratropical cyclones, and estimating the appropriate wind warning category. In this activity, we utilize a HF cyclones best track database that has been created based on OPC's 6-hourly surface analyses during the past two cold seasons of Oct'07 ~ May'08 and Oct'08 ~ May'09. The database tracks the cyclones as they mature and reach HF status, and contains information on the storm center, and the wind warning category issued (based on the Beaufort wind speed scale) for each 6 hour analysis period. Over the two year period, hundreds of ASCAT passes are examined, and compared to wind retrievals from QuikSCAT, and the output of Numerical Weather Prediction models, and where available, to conventional buoy / ship observations. Results indicate that ASCAT low to moderate surface wind speeds remain nearly unchanged, and in very good agreement with independent wind observations. For higher wind speeds, ASCAT retrievals show a smaller low wind bias, and are in closer agreement to QuikSCAT measurements. The reduced high wind speed bias significantly improves the ASCAT capability in detecting extratropical cyclones that reach HF conditions.

Further, we utilize the two year HF cyclones best track file to generate wind field composites, and study the statistics of the wind structure associated with the three wind warning categories (Gale, Storm, HF) within the extratropical cyclones as derived from ASCAT and QuikSCAT wind data. Through monthly composites, it has found that the cyclone wind structure has seasonal variations with strongest and largest distribution of the wind field in the month of February. Composites of the wind field distribution found that HF winds were most frequent within 1000 km of the storm center, and generally located to the west, south west, south and south east side of the center relative to storm mean motion. Storm force winds were observed most frequently within 2000 km of the center. Gale force winds were found to be most frequent within 2500 to 3500 km over the south semicircle relative to the cyclone center and 1500 to 2000 km over the north semicircle.

3. REFERENCES

[1] K. A. Ahmad, J. Sienkiewicz, Z. Jelenak, and P. Chang, "Preliminary Assessment of ASCAT Ocean Surface Vector Wind (OSVW) Retrievals at NOAA Ocean Prediction Center," *Amer. Meteor. Soc.*, Phoenix, AZ, 2009.

[2] D. E. Fernandez, J. R. Carswell, S. Frasier, P. S. Chang, P. G. Black, and F. D. Marks, "*Dual-polarized C- and Ku-band Ocean Backscatter Response to Hurricane ForceWinds*," *J. Geophys. Res., 111, C08013, doi:10.1029/2005JC003048, 2006.*